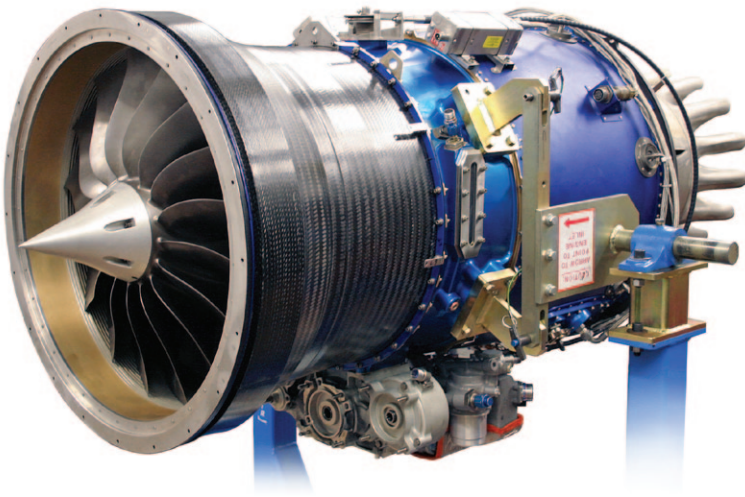


NASA's Composite Case Armor Flying on Cessna Jets



NASA's Glenn Research Center, Williams International, and A&P Technology partnered to develop a composite jet engine fan case that is 30 percent lighter than metal fan cases and strong enough to contain a released titanium blade. The resulting weight reduction translates directly into improved fuel efficiency, lower greenhouse gas emissions, increased payload, and greater aircraft range. During research and testing, Glenn developed laboratory-scale ballistic impact testing and analysis methods that will save millions in aircraft design and development costs compared to approaches that rely on full engine testing. A&P Technology has commercialized numerous spinoffs from the novel braided material they developed for the fan case. Williams International incorporated the composite case armor into its FJ44-4A engine, which is now flying on the Cessna Citation CJ4 aircraft.

Benefits of Technology Transfer

- **Enhances flight safety:** Although loss of a fan blade during flight is a rare event, damage caused by the released blade can be catastrophic. This novel, high-strength technology enables use of the lighter weight materials while maintaining the required level of safety for pilots, crew, and passengers.
- **Sets new standard for industry to follow:** The three-layered case armor is the first ever composite fan case capable of containing a titanium blade during a blade-out event, enabling composites to be more widely used in aeronautics.
- **Lowers greenhouse gas emissions:** Aircraft that use the case armor are more fuel-efficient and reduce harmful CO₂ emissions.
- **Generates additional spinoffs that benefit society:** The collaboration with A&P Technology enabled the use of new braided composite materials in high-pressure storage tanks and pressure vessels. A new NASA research project is underway to apply these lightweight composite materials to reduce the weight of rotorcraft drive systems.

On the Record

“The scientists at NASA Glenn have been valuable partners in the development of this technology. The significant collaboration between NASA and A&P has directly enabled the development of the composite fan containment case now in production at Williams International and has created several jobs.” —*Mike Braley, Vice President of Applications Development, A&P Technology*

“Successful introduction of this new technology was the result of a very effective partnership between government and industry. Key elements of this partnership were a commitment to advanced technology development at A&P Technology, an emphasis on product innovation at Williams International, and a focus on challenging research at NASA.” —*Dr. Gary Roberts, Materials Research Engineer, NASA’s Glenn Research Center*

About A&P Technology

A&P Technology, based in Cincinnati, Ohio, is a family-owned producer of precision braided textiles. A&P’s production braids are used in a variety of applications ranging from satellites to deepwater oil wells. For over 20 years, A&P has supported large volume programs such as containment for GE aircraft engines, braided composite propellers used on general aviation and commercial aircraft, and airbag materials for BMW, Land Rover, Mini Cooper, and Cadillac Escalade.

About Williams International

Williams International, headquartered in Commerce Township, Michigan, is a leader in the development and manufacture of small gas turbine engines. A second facility in Ogden, Utah, is the most modern and efficient design-to-production gas turbine facility in the world.

Technology Origins

NASA has pioneered efforts to incorporate lightweight composites into aerospace structures and components. The standard jet engine fan case represents the heaviest static structure on the engine because of its size and requirement to contain a blade released during engine operation. Glenn wanted to develop more lightweight, damage-tolerant fan casings for jet engines.

The Transfer Process

Through a Small Business Innovation Research (SBIR) contract, Glenn partnered with A&P Technology to develop several approaches for using lightweight composite materials in the fan case. A&P developed a unique braided composite material and manufacturing process for composite fan cases that were 30 percent lighter than the current metal fan case technology. NASA and A&P Technology then partnered with Williams International to optimize the fan case. A new three-layer design (one metal layer and two optimized composite layers) was developed using ballistic impact tests and analysis methods developed at NASA. Williams provided expertise from previous engine tests and also provided the metal components used in testing. The test results were so impressive that

Williams International—who previously had no intention of immediately incorporating composite materials in their fan cases—chose to move forward with composite fan case development for its new engine. Using low-cost test and analysis methods developed by NASA, Williams International developed a layered composite fan case for their new FJ44-4A engine.

Commercial Success

The Williams International FJ44-4A engine, with the layered composite fan case, is now flying on the Cessna Citation CJ4 aircraft, a light jet developed by Cessna for its CJ line of Citation business jets. The CJ4 aircraft, which debuted the Williams FJ44-4A engine and its composite case armor, has been an extraordinarily successful product that has consistently exceeded performance requirements. When compared to Cessna’s original projections, the aircraft weighs less when empty, has more thrust, flies farther, needs less runway, and consumes less fuel.

A&P Technology also went on to develop several spinoffs as a result of their partnership with NASA. The company discovered that the braided composite material can be used in the manufacture of high-pressure storage tanks and pressure vessels. In addition, A&P partnered with GE Aviation (GEAE) to develop a braided jet engine fan case for its GENx engine, the most fuel-efficient, quiet, and low-emissions jet engine that GEAE has ever introduced for large jet aircraft. The GENx, now flying on the new Boeing 787 aircraft and the Boeing 747-8, has become the fastest-selling, high-thrust jet engine in GE Aviation’s history.

For More Information

If you would like additional information about Glenn’s technology transfer opportunities, please contact:

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